Forest Health in Alberta
Annual Report
2012

Alberta
Government

2012 Annual Report
Forest Health Program
Environment and Sustainable Resource Development

Forest Health Vision

To lead Canada in science-based, proactive, adaptive and innovative management of forest health damaging agents in a forest environment with a multitude of values and challenges posed by a changing climate.

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Cover Photo: Pine trees infected with red ring blight (Tom Hutchison)

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The Forest Health Section staff at the Provincial Headquarters (Erica Samis - Senior Forest Health Officer, Mike Undershultz – Forest Health Officer, Anina Hundsdoerfer – Forest Health Officer, and Brooks Horne – Forest Health Officer) under the guidance of Daniel Lux (Senior Manager of Forest Health), planned and formulated the 2012 forest health program. The Regional Forest Health Officers (Andrea Sharpe – Foothills, Brad Jones – Southern Rockies, Caroline Whitehouse – Peace River/Upper Hay, Dale Thomas – Lesser Slave, Devin Letourneau – Smoky, Kristofer Heemeryck – Clearwater, Seena Handel – Woodlands, and Tom Hutchison – Waterways/Lac La Biche) planned surveys conducted in 2012 in their corporate areas. The Regional Forest Health Officers and/or the Forest Health Technicians (Bart McAnally – Southern Rockies, Caroline Charbonneau – Foothills, Jenn MacCormick - Lesser Slave, Marian Jones – Clearwater, Martin Robillard – Waterways/ Lac La Biche, and Pam Melnick – Smoky) conducted overview and detailed aerial surveys, carried out ground-checks to verify damaging agents and, deployed traps to monitor populations of forest health damaging agents. They submitted survey data to Aaron McGill - Senior Information Management Technologist - at the Provincial Headquarters for processing. Aaron McGill checked and processed forest health data collected before preparing the maps that appear in this report.

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Executive Summary

This is the 2012 annual report of the Forest Health Program of the Forestry and Emergency Response Division of Environment and Sustainable Resource Development. This report contains details of detection, monitoring, assessment and management of forest health damaging agents that affected the forested Crown land in the Green Area of Alberta, and related programs carried out in 2012.

In 2012, the mountain pine beetle, eastern spruce budworm, aspen defoliators, red ring blight of pine, damage caused by abiotic agents such as wind, drought, hail, red belt and flooding affected forest trees in the Green Area. In addition, invasive plant species threatened biodiversity of the forested Crown land. Also described here are other forest health-related programs.

In 2012, the mountain pine beetle was the main forest health damaging agent in Alberta. In the 2011 'beetle-year' reported here, long distance dispersal monitoring did not indicate influx of beetles into the province. There was no further expansion of mountain pine beetle infestations, compared to the previous year. Heli-GPS surveyors detected nearly 246,000 pines symptomatic of beetle-infested trees in the year under review. In northern Alberta, decline of beetle infestations in the Upper Athabasca Corporate Region is attributed to aggressive management action taken. In southern Alberta, where no aggressive management action was necessary, decline in beetle infestations during this period is attributed to control actions taken in previous years, lack of beetle influx, and inclement weather conditions prevailing at the time of beetle dispersal. Aerial photography in the inactive holding zone, where no management action was taken, recorded around 1.9 million pines with red crowns in beetle-infested stands. The green to red survey results indicated decreasing beetle populations in the Upper Athabasca Corporate Region and increasing beetle populations in the Upper Peace Corporate Region. Ground surveyors detected around 131,000 green attack pines in the leading and holding management zones. During treatments, all of beetle-infested green attack trees were removed. The results of r-value surveys indicated lower beetle success in the 2011 beetle-year than in the previous year.

The eastern spruce budworm defoliations in 2012 were confined to northern Alberta. The budworm-defoliated area remained relatively low at about 29,000 net hectares, a 19.4 per cent decrease compared to the area defoliated in 2011. However, net area with severe defoliation increased by about two-fold in 2012, compared to that in 2011. Forecast based on the

results of male moth survey indicated a moderate to high risk of budworm infestations occurring at some locations in the Lower Peace and in the Lower Athabasca corporate regions in 2013; elsewhere in the province this risk was nil to low.

The western spruce budworm populations in southwest Alberta collapsed in 2012. Consequently, there was no aerially visible defoliation caused by this agent.

In 2012, the gross area of aspen defoliated by forest health damaging agents increased nine-fold, compared to that observed in 2011, to reach around 629,000 hectares. Approximately, 50 per cent of this area was severely defoliated indicating potential increase in these populations in 2013, barring incidence of natural enemies. The forest tent caterpillar caused almost all of aspen defoliation in 2012.

The red ring blight of pine was detected on high value pines growing at the Alberta Tree Improvement and Seed Centre. This is the first report of red ring blight affecting pines in Alberta. In recent years, virulence of this pathogen has increased resulting in large-scale tree kills in pine plantations of British Columbia. In view of this increase, the Forest Health Section is planning a spray program in 2013 to control this disease at the Alberta Tree Improvement and Seed Centre. Fungal pathogens belonging to Rhabdocline spp. caused needle cast in Douglas fir in southern Alberta.

Compared to the impact caused by abiotic forest health damaging agents in 2011, there were fewer incidences caused by these agents in 2012. Among the abiotic agents affecting forest trees in 2012 were aspen dieback, blowdown, drought, hail, red belt and flooding. However, the extent of forested land affected by these agents in 2012 was much lower than the extent of forested land affected by these agents in 2011.

Forest Health crews surveyed selected locations in the Green Area of the province to detect and monitor occurrence of invasive plant species. Among the invasive plant species found during these surveys were four prohibitive noxious species. This year hawkweeds, some of which are prohibitive noxious weeds, posed serious problems in managing invasive plant species in the province. In 2012, ecological, mechanical and herbicidal treatments were used to manage invasive plant species. The Northeast Weed Co-op Workshop held in Athabasca was the highlight of several programs conducted to increase invasive plant awareness of stakeholders.

Among the collaborative programs reported here are:

- monitoring 'Climate Impact on the Productivity and Health of Aspen' plots,
- mountain pine beetle Spread Management Action Collaborative,
- cooperative action with the Terrestrial Environment Effects Monitoring Program of the Wood Buffalo Environmental Association,
- deploying traps to detect gypsy moths,
- Whitebark and Limber Pine Recovery Plan, and
- activities to increase forest health awareness.

Introduction

This is a report on programs carried out by the Forest Health Section of the Forestry and Emergency Response Division of Alberta Environment and Sustainable Resource Development (ESRD) in 2012. Details of other forest health-related programs carried out in Alberta in 2012, that are either linked to or have a direct bearing on programs carried out by the Forest Health Section, are also reported in this document.

These programs were carried out over a forested and wooded land base that is 36.4 million hectares in extent. Nearly 50 per cent of the forested land in Alberta is covered by softwood species, another 32 per cent is covered by hardwood species and the balance of 18 per cent is covered by mixed-wood species. Almost 90 per cent of this forested land is under provincial jurisdiction.

The forest health program consists of annual overview and detailed aerial surveys, aerial photography in selected areas, and ground surveys to detect, verify and monitor forest health damaging agents. The details of these surveys and resulting programs conducted in 2012 for managing forest tree damaging agents are reported in this document. Furthermore, the incidence, distribution, increased awareness and management of noxious and prohibited noxious invasive plant species on forested lands in the Green Area of the province are also reported. This report includes an account of activities that were carried out by the Forest Health Section in collaboration with other agencies. Also reported here are activities carried out in 2012 to increase forest health awareness among the stakeholders and the general public.

Many tree damaging agents including insects, pathogens, invasive plant species and abiotic factors affect trees in Alberta's forest landscape. However, surveys of these damaging agents are limited to those areas that have a high priority from either operational or ecological points of view. In 2012, damage caused by the mountain pine beetle (MPB), the eastern spruce budworm, major aspen defoliators, the red ring blight of pines, major abiotic factors, and major invasive plant species were surveyed.

The technical details and standards of survey procedures are available from the Forest Health Section of ESRD's Forest Management Branch.

The digital maps of aerial overview surveys showing spatial distribution of pest damage are available either on the external Forest Health website or on the MPB website. Alternately, digital maps showing survey results can be requested from the Senior Manager of Forest Health.

Among the collaborative programs reported here are the gypsy moth detection survey carried out in collaboration with the Canadian Food Inspection Agency (CFIA); the whitebark pine and limber pine recovery program implemented in collaboration with the Fish and Wildlife Branch of the Policy Division of ESRD; monitoring permanent plots established to study Climate Impact on the Productivity and Health of Aspen (CIPHA) conducted on behalf of the Canadian Forest Service of Natural Resources Canada; MPB Spread Management Action Collaborative (SMAC) between the ESRD and the Saskatchewan Ministry of Environment; and, cooperative action with the Terrestrial Environment Effects Monitoring (TEEM) Program of Wood Buffalo Environmental Association.

This report contains details of the following:

1. The mountain pine beetle (MPB) program including results of surveys carried out by using aggregation pheromone-baited trees to detect long-distance aerial dispersal, results of aerial surveys and aerial photography carried out to detect pine trees with red crowns symptomatic of MPB attack, results of ground surveys to detect population trends, and beetle-focussed level-1 single tree treatment.
2. The historical aspects, spatial distribution of defoliation, population trends, and the extent and severity of damage caused by the eastern spruce budworm.
3. The spatial distribution, extent and severity of damage caused by major aspen defoliators.
4. Detection, incidence and plans to manage the red ring blight of pines.
5. The spatial distribution and severity of damage due to abiotic forest tree damaging agents.
6. The Invasive Plants Program including steps taken to increase awareness, ground surveys, and management programs carried out at selected sites in the Green Area.
7. Forest health-related collaborative programs carried out in cooperation with other agencies, and
8. Processes used to increase forest health awareness.

Forest pest-related data are reported on a corporate regional basis. Appendix I shows the ESRD corporate regions and corporate areas in Alberta, in 2012.

The surveys reported in this document were carried out for operational purposes over forested Crown land over the Green Area of Alberta. These surveys do not necessarily cover the entire forested land base. Although every effort is made to ensure accuracy and completeness of this report, its integrity is not guaranteed by the ESRD.

Forest Health Damaging Agent Conditions and Management Programs in 2012

Bark Beetles

Mountain Pine Beetle, *Dendroctonus ponderosae*

Introduction

The current MPB infestation in forested Crown lands of Alberta has been ongoing since 2002.

The objectives, principles and actions of Alberta's MPB program are outlined in the Mountain Pine Beetle Management Strategy that can be found at the following link: (http://mpb.alberta.ca/AlbertasStrategy/documents/MPB_man_strategy.pdf).

The details of the MPB management program reported here cover the 2011 beetle-year, i.e., period from August 15, 2011 to August 14, 2012. This period approximately coincides with the time between MPB flights in 2011 summer to disperse and locate host trees to lay eggs, followed by the completion of the life cycle of emerging larvae resulting in adult beetles that emerged and flew in 2012 summer. This report covers the current MPB outbreak and details of the following activities:

- detection and assessment of 2011 MPB infestations;
- actions taken to manage these infestations; and
- ground surveys carried out to forecast 2012/13 MPB population trends.

These activities are discussed in detail below.

Detection and Assessment of MPB Infestations

Long-Distance Dispersal Monitoring

In each one of the strategically pre-selected townships, a monitoring plot with MPB aggregation pheromone-baited pine trees was established prior to onset of MPB flights in July. Each beetle-monitoring plot was set up in a highly MPB-susceptible pine stand. In September, after beetle flights, the baited trees in these plots were checked for beetle-hits.

Figure 1 shows the results of long-distance dispersal monitoring of MPB in 2011. These results indicated relatively lesser percent of plots with MPB-hits in 2011 compared to that in 2010 (Figure 2). In 2011, there was no indication of beetle-hits either further north or further east than what was observed in 2010. These results imply lack of major beetle influxes into the province and a relatively lesser long-distance dispersal of beetles within the province in 2011.

Figure 1. Results of pheromone-based long-distance aerial dispersal monitoring of MPB from July to September 2011 in Alberta.

Figure 2. Results of pheromone-based long-distance aerial dispersal monitoring of MPB from July to September 2010 in Alberta.

Aggregation pheromone-baited pine tree used for tracking long-distance MPB dispersal in Alberta (Anon., ESRD).

Detection of MPB-symptomatic Trees

MPB-symptomatic trees were detected in 2011 by heli-GPS surveys and by aerial photography.

Heli-GPS Surveys

From August 15 through September 15, heli-GPS surveyors recorded locations of pine trees with red crowns symptomatic of MPB infestations. These surveys covered areas in the leading and holding zones (see page 15) where ground surveys and control action most likely were to be carried out. Figure 3 shows the results of the overview heli-GPS surveys carried out in fall 2011. The surveyors detected 245,879 pines symptomatic of MPB attacks. The number of pines symptomatic of MPB attacks detected in 2011 was lower in comparison to that in 2010 in the common areas covered by the surveys in the Upper Athabasca Corporate Region. This is attributed to active MPB management action implemented in this corporate region. There was a further decline of MPB symptomatic pines in the North and South Saskatchewan corporate regions in 2011. This is most likely because of low levels MPB populations as a result of control programs implemented in previous years, lack of MPB influx from British Columbia, and inclement weather conditions prevailing at the time of beetle flights. However, these corporate regions still are at risk of MPB infestations.

Heli-GPS surveys carried out in the holding zone did not cover the same areas from year to year. Hence, the survey results in 2011 in the holding zone could not be compared with those in 2010.

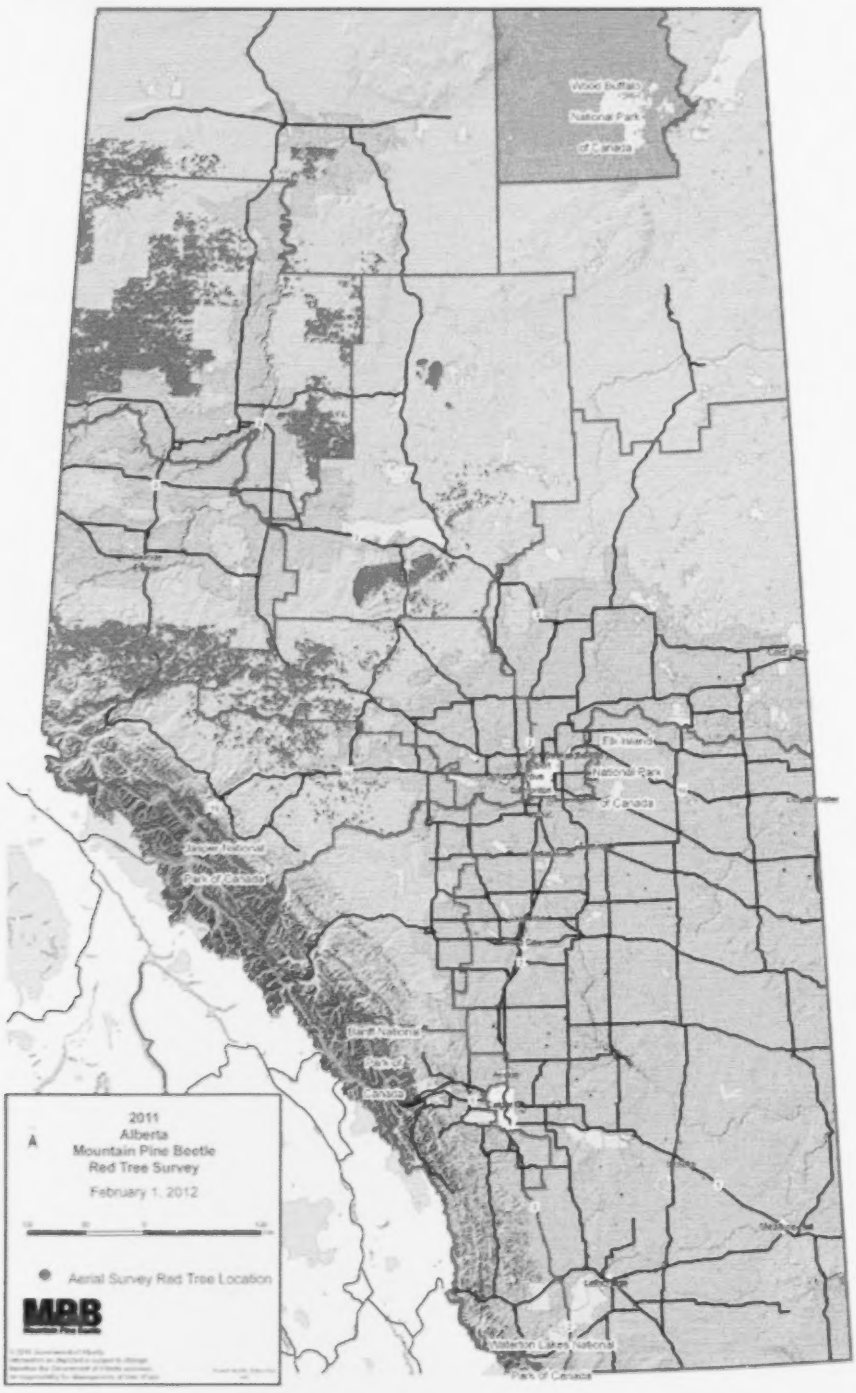
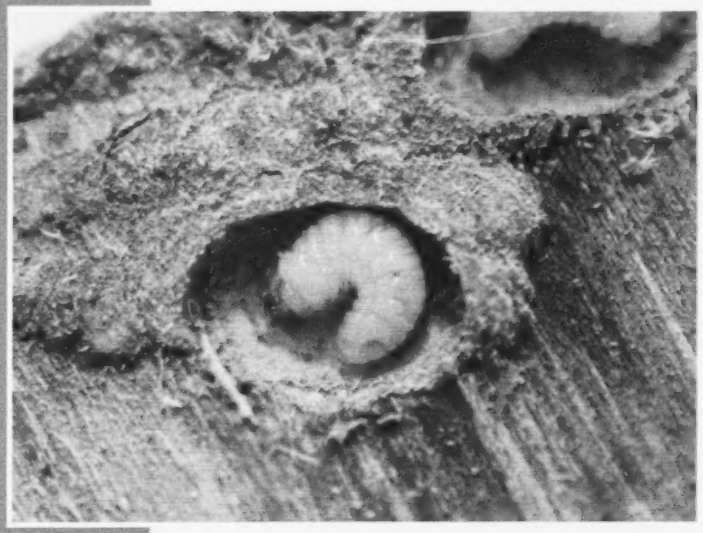


Figure 3. Results of heli-GPS aerial surveys (leading and holding zones) and aerial photography (inactive zone) carried out to detect MPB-symptomatic pines in 2011 fall in Alberta.



Mature mountain pine beetle larvae (Mike Maximchuk)

Aerial Photography

Two contractors carried out aerial photography over pre-selected areas covering approximately 312 townships to record MPB-symptomatic trees in the Upper Peace and Lower Peace corporate regions. The areas covered included the northwest part of the Smoky Corporate Area and the S21 Forest Management Unit (FMU) in the Slave Lake Corporate Area.

Altogether 1,934,799 pine trees with red crowns were identified by aerial photography. However, the areas covered by aerial photography have had MPB infestations for several years. Hence, in aerial photos it was not possible to distinguish pines with current year red attack from those with older red attacks. In any case, these aerial photography results are not used to facilitate survey and control work. Instead, these results are used to determine changes in extent of tree mortality and to identify potential areas for rehabilitation.

Green to Red Ratios

The green to red ratios are the ratios of green attacks (trees with current year attacks still retaining green crowns) to red attacks (trees with red crowns attacked in the previous year). This ratio indicates the relative success of beetle populations and potential for their spread from the sites.

The green: red ratios in 329 plots were determined in 2011 fall. Figure 4 shows the results of these surveys. A green to red ratio of >1 indicates an increasing population, a ratio of 1 indicates a static population and a ratio <1 indicates a declining population. The survey results showed that beetle populations were decreasing in the Upper Athabasca Corporate Region but increasing in the Upper Peace Corporate Region in west-central Alberta.

Ground Surveys to Detect Green Attacks

Ground crews surveyed 7,935 sites in 2011 fall to detect green attack trees in the leading and the holding zones. These surveys were based on locations of red attack trees that were detected during heli-GPS surveys. Altogether, ground surveyors detected 130,731 green attack trees that were earmarked for control.

Infested-Tree Treatment Under the MPB Management Program

A Decision Support System (DSS) supported by the geographic information system is used to prioritize sites with MPB-infested trees for survey and control. This DSS helps to divide beetle-infested sites detected by heli-GPS surveyors into five categories of MPB spread risk, varying from very low to extreme. This spread risk is based on beetle biology and stand characteristics. The goal is to control infested trees in at least 80 per cent or more of the sites ranked as having moderate, high or extreme risk of spread within the leading and holding zones (Figure 5).

The MPB-infested trees were treated by:

- level 1 single-tree control by ESRD;
- single-tree control by municipalities under an ESRD grant program; and
- ESRD modified level 1 control.

Level 1 Single-Tree Control

ESRD awarded contracts to companies to conduct level-1 single tree control. Under this control program 130,529 MPB-infested pines were removed.

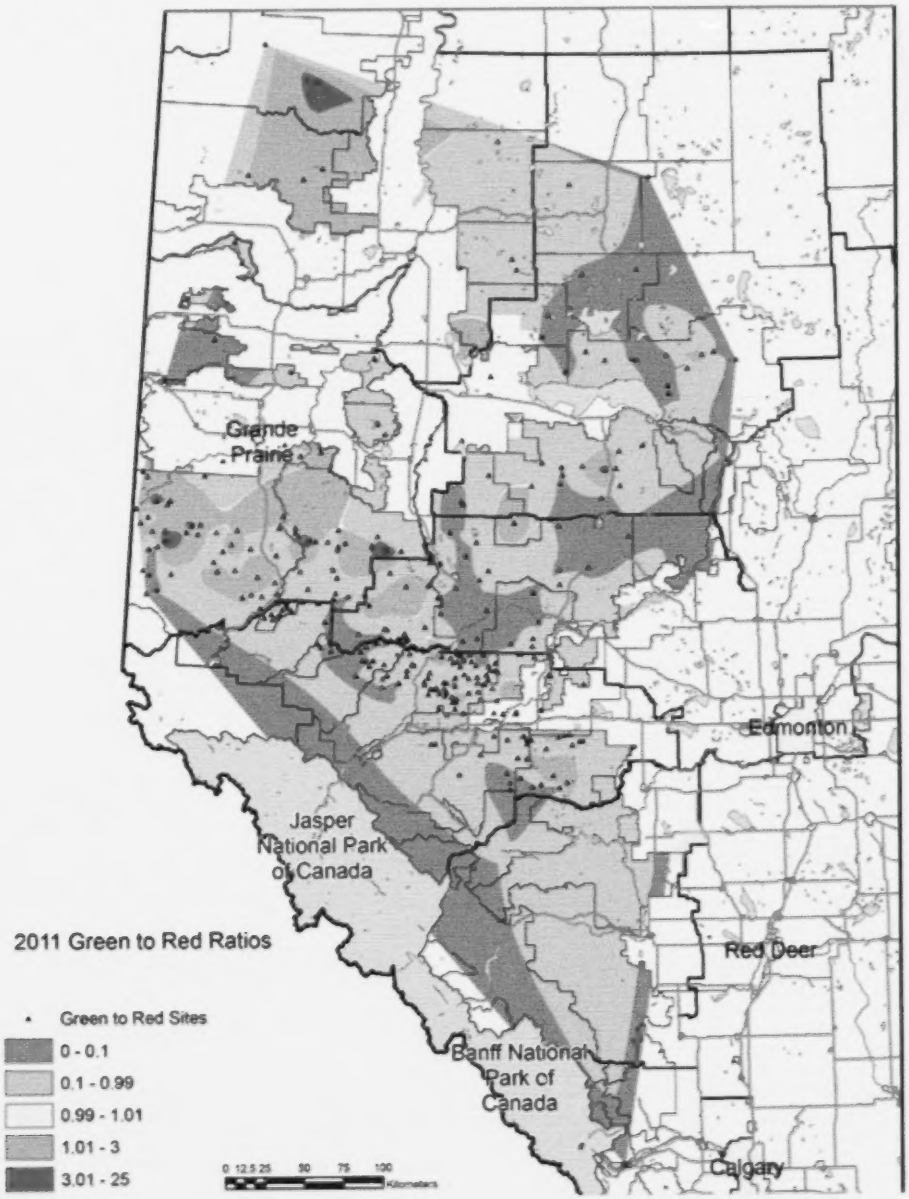


Figure 4. Results of MPB green to red ratio survey carried out in 2011.

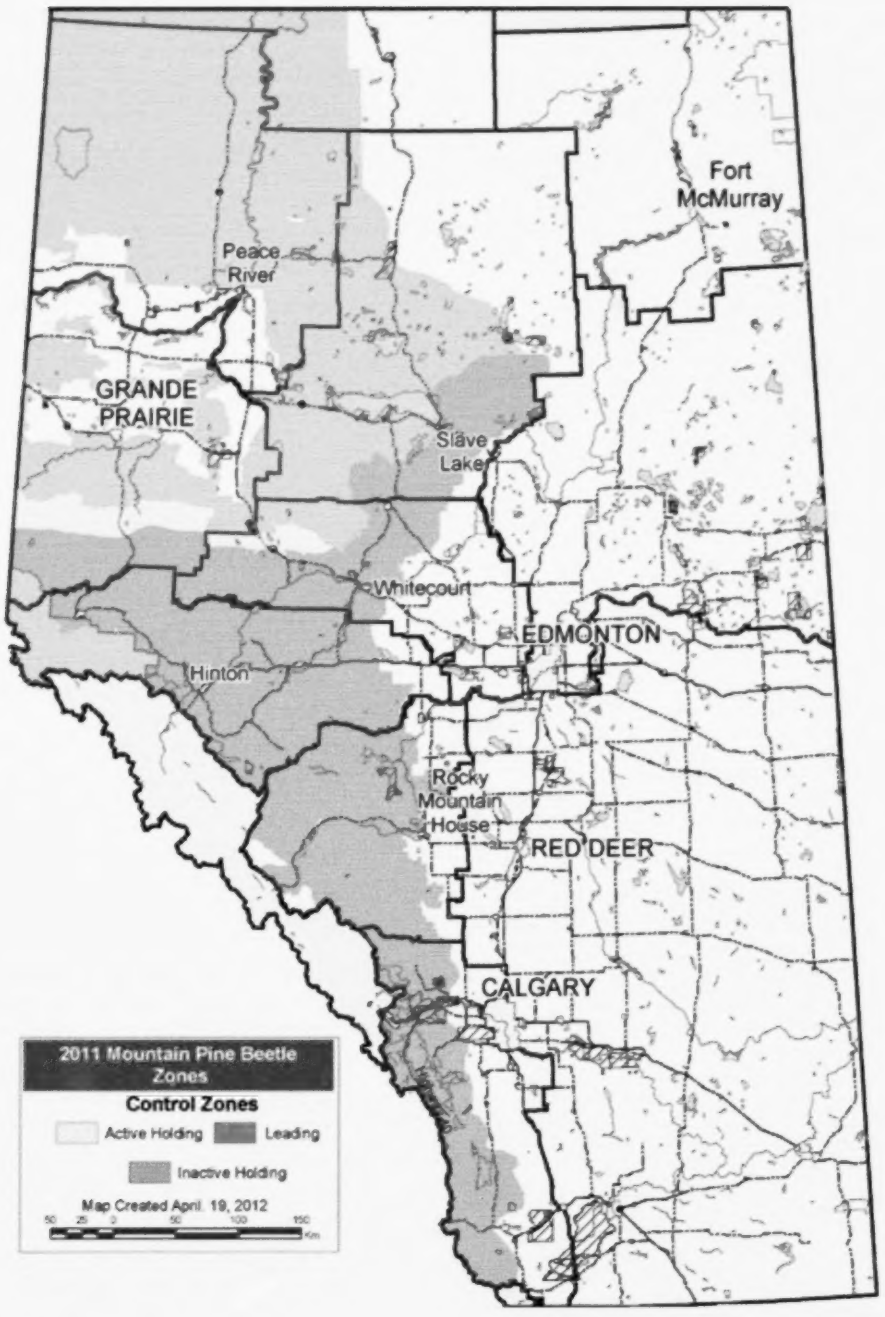


Figure 5. MPB management zones in Alberta in the 2011 beetle-year.

Single Tree Control by Municipalities

ESRD administers a Municipal Grant Program that provides funding support for municipalities in the leading zone to conduct MPB management activities. During the 2011 beetle-year, three municipalities removed 49 MPB-infested pines under the ESRD grant program. The municipalities involved in this program were the Town of Whitecourt, Woodlands County and Yellowhead County.

ESRD Modified Level 1 Control

For the first time, a Modified Level 1 control program was carried out over the Smoky Corporate Area. Areas heavily infested with MPB were demarcated and all the pine trees within the marked areas were mechanically felled and burned on site. Altogether 190 hectares were treated by this method under three contracts. This tactic was economical but it has limited applicability making it usable only under specific circumstances.

Forecasting Population Trends

R-values

The r-value is a measure of relative success of an MPB population. It measures the number of beetles attacking a tree versus the number of beetles that successfully develop and emerge from that tree to attack new trees. Figure 6 shows the projections for relative success of MPB populations, based on r-values calculated using the 2012 spring survey data.

In Figure 6, projections for extremely successful beetle populations are shown in red and those of highly successful beetle populations are shown in brown. Both of these categories indicate increasing beetle populations. The projections for static MPB populations are shown in yellow and the projections for decreasing beetle populations are shown in blue. Based on r-values, the beetles in 2012 were less successful (Figure 6), compared to the beetles in 2011.

R-value samples (Anon., ESRD)

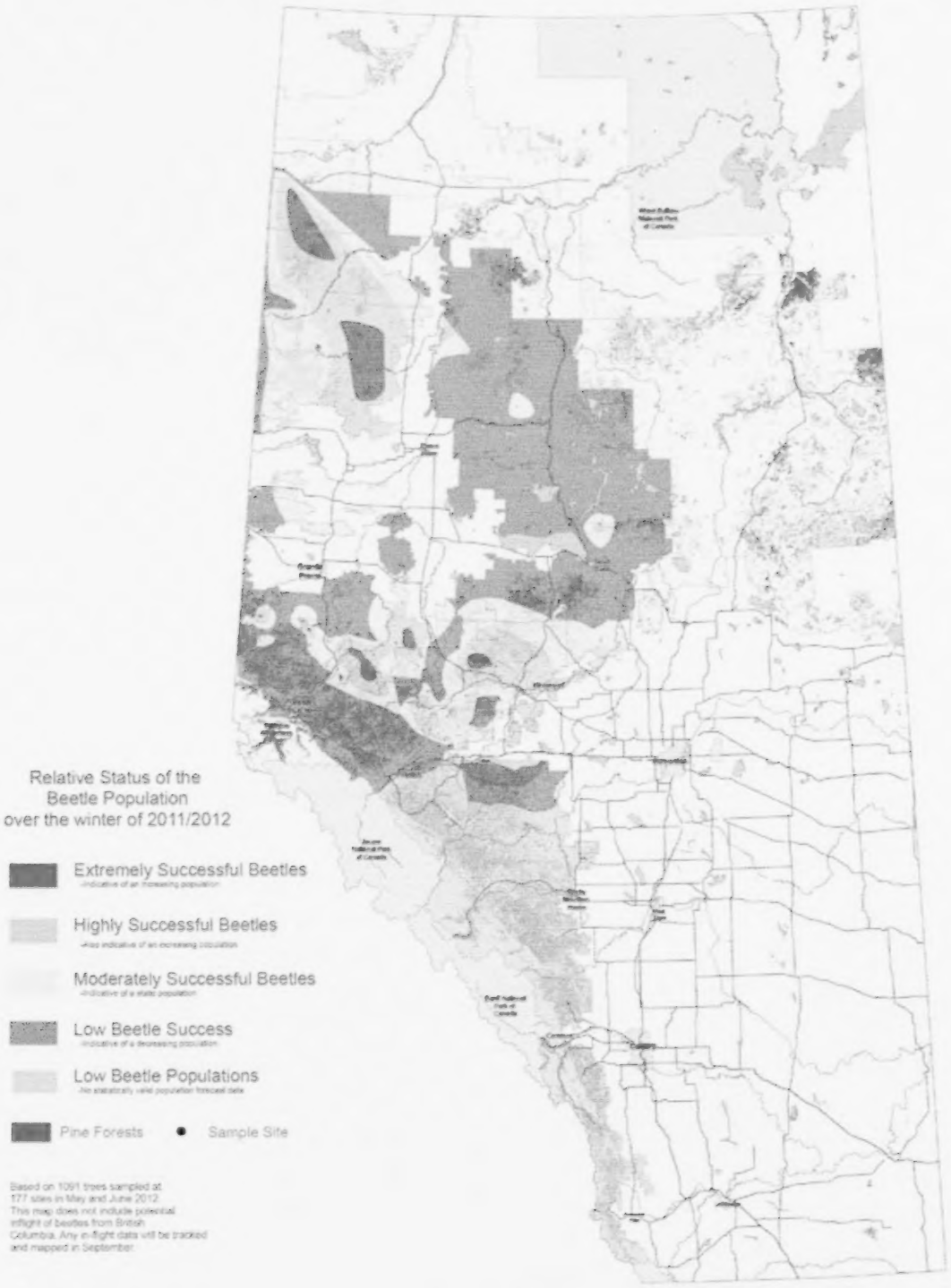

Relative Status of the
Beetle Population
over the winter of 2011/2012
Extremely Successful Beetles
Highly Successful Beetles
Moderately Successful Beetles
Low Beetle Success
Low Beetle Populations
Pine Forests
Sample Site
Based on 1091 trees sampled at
177 sites in May and June 2012.
This map does not include potential
inflight of beetles from British
Columbia. Any in-flight data will be tracked
and mapped in September.

Figure 6. Projections on relative success of MPB populations in 2012, based on the r-values calculated using 2012 spring survey data.

Conifer Defoliators

Eastern Spruce Budworm, *Choristoneura fumiferana*

Historical

The eastern spruce budworm is a native defoliator that has co-evolved with white spruce and balsam fir stands. Over the last 50+ years, budworm infestations in the province have occurred mainly in river valleys of northern Alberta. Spruce budworm infestations that occurred in southern Alberta during this period have been few and far between. Figure 7 is a composite map showing the spatial distribution and extent of eastern spruce budworm outbreaks in Alberta between 1950 and 2004.

Detection and Assessment

The Forest Health Officers and/or Technicians annually carry out overview aerial surveys to detect and assess spruce budworm defoliated stands on forested Crown land. The goals of this program are:

- to keep a historical record of these infestations, and
- to assess the need to take management actions if spruce budworm infestations could compromise the land management objectives.

Figure 8 shows the extent and severity of spruce budworm defoliations in Alberta, 2008-2012.

Figure 7. Spatial distribution of eastern spruce budworm outbreaks in Alberta, 1950-2004 (Data courtesy of Canadian Forest Service, Northern Forestry Centre).

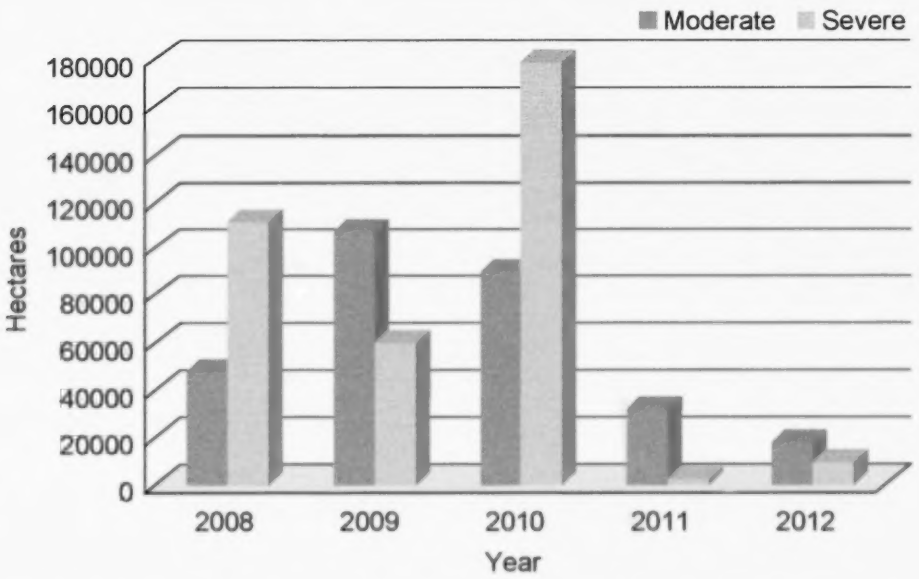


Figure 8. The extent and severity of spruce budworm defoliations in aerially surveyed areas of Alberta, 2008 – 2012.

Figure 9 shows the results of the 2012 overview aerial surveys carried out to detect and assess spruce budworm infestations. In 2012, aerially visible budworm defoliation was confined to the Lower Athabasca and the Lower Peace corporate regions in northern Alberta.

Aerially visible spruce budworm defoliation in Alberta covered an estimated net area of 28,530 hectares in 2012. In this area, spruce budworm severely defoliated an estimated 10,373 hectares and moderately defoliated an estimated 18,157 hectares. Compared to the budworm-defoliated area in the province in 2011, there was a 19.4 per cent drop in the overall budworm-defoliated area in 2012. The moderately budworm-defoliated area in the province dropped by 44 per cent while severely defoliated area increased by 223 per cent in 2012, compared to those in 2011 (Table 1).

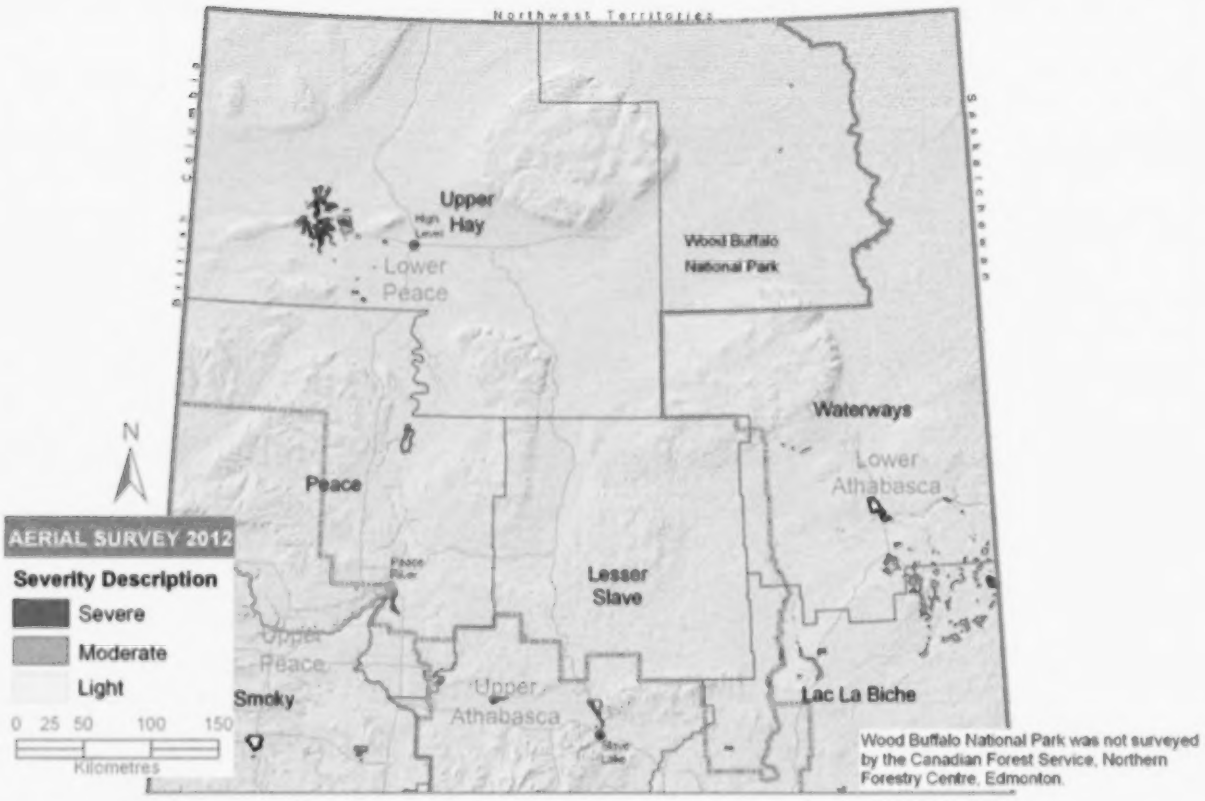


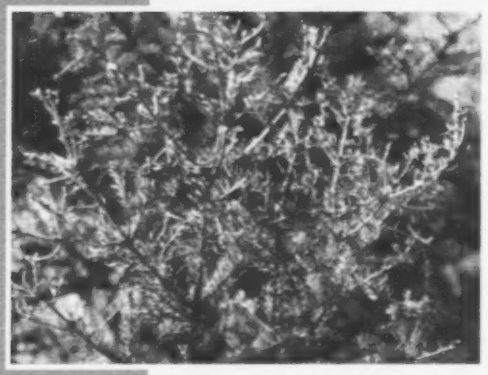
Figure 9. Spatial distribution of aerially visible spruce budworm defoliation over forested Crown land of the Green Area surveyed in 2012 in Alberta.

Table 1. The extent (hectares) of spruce budworm defoliation recorded, under each severity category, during overview aerial surveys carried out in the Green Area of Alberta in 2011 vs. 2012

Severity Category[2]	2011	2012	Change[1]
Moderate	32,195	18,157	-44 per cent
Severe	3,208	10,373	223 per cent
Total	35,403	28,530	-19.4 per cent

[1] per cent change compared to 2011 figures

[2] moderate = 35-70 per cent of new foliage defoliated; severe = over 70 per cent of new foliage defoliated



White spruce branch severely defoliated by the spruce budworm (Anon., ESRD)

Table 2 shows a comparison of 2012 spruce budworm defoliation, by severity categories, in the ESRD corporate regions. In the Lower Athabasca Corporate Region, budworms defoliated an estimated net area of 11,578 hectares. In this corporate region, defoliation was moderate over 10,893 hectares, an increase of 146 per cent compared to the 4,431 hectares moderately defoliated in 2011; defoliation was severe over 685 hectares in 2012 compared to no severe defoliation observed in this corporate region in 2011. In the Lower Peace Corporate Region, budworms defoliated an estimated net area of 16,952 hectares. In this corporate region, budworm defoliation was moderate over 7,264 hectares in 2012, a decrease of 74 per cent compared to 27,764 hectares with moderate defoliation in 2011; defoliation was severe over 9,688 hectares in 2012, an increase of 202 per cent compared to 3,208 hectares with severe defoliation in 2011.

Table 2. The extent (hectares) of spruce budworm defoliation recorded, under each severity category, in the ESRD corporate regions of Alberta in 2012

Corporate Region	Corporate Area/s	Extent of Defoliation		
		Moderate	Severe	Total
Lower Athabasca	Lac La Biche Waterways	10,893	685	11,578
Lower Peace	Lac La Biche Lesser Slave Peace Upper Hay Waterways	7,264	9,688	16,952
Total		**18,157**	**10,373**	**28,530**

Mature spruce budworm larva (Devin Letourneau)

Forecast on Risk of Budworm Infestations Occurring in 2013

In 2012, at each of 162 sites located across the Green Area of the province two traps baited with female sex pheromone lures were deployed. The survey was completed at 161 sites; at one site both traps went missing.

Figure 10 shows the forecast on risk of spruce budworm infestations occurring in 2013, based on trap catches of male moths in 2012. Overall, 113 sites (70 per cent) had trap catches indicating nil-low risk; 42 sites (26 per cent) had trap catches indicating moderate risk and six sites (four per cent) had trap catches indicating high risk of spruce budworm infestations occurring in 2013.

Male budworm moth catch in a pheromone-baited trap (Tom Hutchison)

There is a moderate risk of infestations occurring at 42 sites scattered over South Saskatchewan, Lower Athabasca, and the Lower Peace corporate regions. The risk of budworm infestations occurring in 2013 is high at four sites in the Lower Peace Corporate Region and at two sites in the Lower Athabasca Corporate Region.

Figure 10. Forecasted risk of spruce budworm infestations occurring in 2013 in Alberta, based on male moth catches in pheromone-baited traps deployed in 2012.

The risk of spruce budworm infestations occurring in 2013 by the corporate areas is shown in Figure 11.

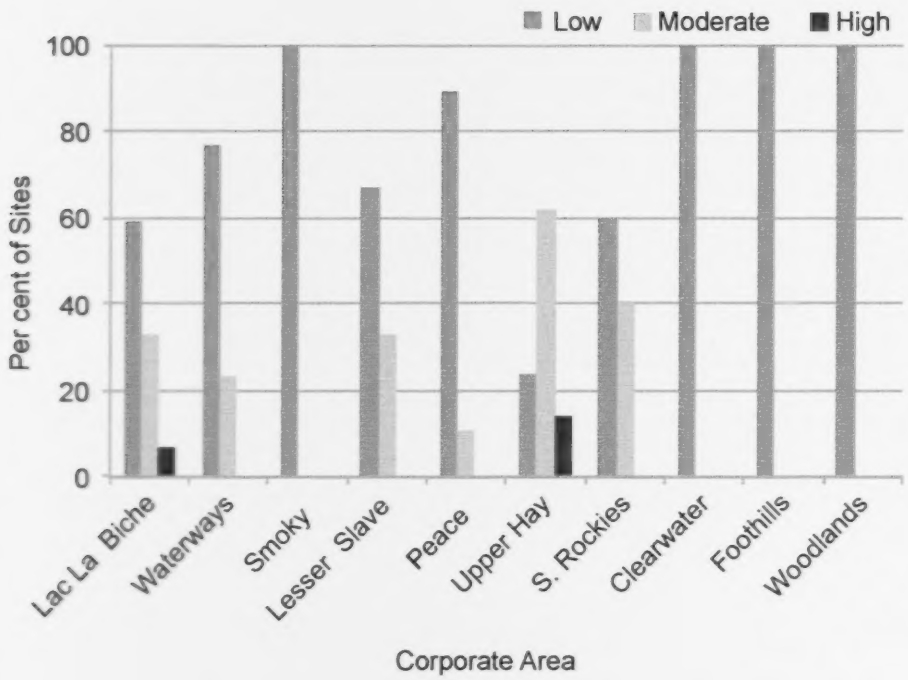


Figure 11. The percent of pheromone-baited trap sites in each corporate area that fell into each spruce budworm outbreak risk category in 2013 in Alberta.

The sites located in the corporate areas of Smoky, Clearwater, Foothills and Woodlands have a nil-low risk of budworm infestations occurring in 2013. The sites in the corporate areas of Waterways, Lesser Slave, Peace and Southern Rockies have low to moderate risk of budworm infestations occurring in 2013. Sites located in the Lac La Biche and Upper Hay corporate areas have risks of budworm infestations occurring varying from low to high in 2013; however, in each of these areas, less than 20 per cent of sites have high risk of infestations.

Western Spruce Budworm, *Choristoneura occidentalis*

The western spruce budworm populations in southern Alberta collapsed in 2012. No aerially visible defoliation caused by this pest was observed over the areas previously affected by this pest.

Broadleaf Defoliators

Aspen Defoliators

Detection and Assessment

Annually, the Forest Health Officers and/or Technicians carry out overview aerial surveys to record the gross area over which aspen defoliation caused by forest health damaging agents is scattered. They use severity category ratings to record the intensity of defoliation. The objective of these surveys is to maintain a historical record of forest damaging agent-caused aspen defoliation over the Green Area of the province. Such a record will let forest health practitioners follow the long-term trends of aspen defoliation in relation to changes in biological and environmental factors. It will also highlight emergence of hitherto innocuous agents as forest health damaging agents. These surveys provide data to assess the impact of these damaging agents and to decide on the need to take control action if their impacts are compromising the forest management objectives. Finally, such records are used in compiling a national data base on incidence and impact of such pests across Canada.

Mature forest tent caterpillar larva and damaged aspen leaves (Mike Maximchuk)

Figure 12 shows spatial distribution of aspen defoliator-caused defoliation over the aerially surveyed areas of the Green Area in Alberta. In 2012, the area over which aspen defoliation scattered significantly increased compared to that in 2011. In total, aspen defoliation covered a gross area of 629,112 hectares. This is almost a nine-fold increase in the area affected by aspen defoliators in 2011. Defoliation was light over 132,924 hectares (21.1 per cent), moderate over 193,491 hectares (30.8 per cent) and severe over 302,697 hectares (48.1 per cent). Compared to the corresponding figures in 2011, the extent of light defoliation increased by 81 per cent, moderate defoliation increased by nearly 445 fold and severe defoliation increased by an astounding 17,800 fold, in 2012 (Table 3).

The forest tent caterpillar was the dominant defoliator of aspen in 2012. The large aspen tortrix defoliation was confined to a 462-hectare block in the South Saskatchewan Corporate Region and a 115-hectare block in the Lower Athabasca Corporate Region. There was no Bruce spanworm-caused aspen defoliation in the Green Zone in 2012 (Table 4).

Figure 12. Spatial distribution of aerially visible forest health damaging agent-caused aspen defoliation recorded during aerial surveys over the Green Area of Alberta in 2012.

Table 3. The extent (hectares) of aspen defoliation, by severity categories, in the ESRD corporate regions of Alberta, 2011 vs. 2012

Corporate Region	Defoliation Severity 2011			Total in 2011	Defoliation Severity in 2012			Total in 2012
	Light	Moderate	Severe		Light	Moderate	Severe	
Lower Peace	2,202	121	0	2,323	56,065	131,349	150,656	338,070
Upper Peace	50,327	0	0	50,327	47,693	23,881	150,229	221,803
Lower Athabasca	2,555	0	0	2,555	10,100	7,702	0	17,802
Upper Athabasca	18,255	313	17	18,585	19,023	30,097	1,812	50,932
North Saskatchewan	0	0	0	0	43	0	0	43
South Saskatchewan	0	0	0	0	0	462	0	462
TOTAL	**73,339**	**434**	**17**	**73,790**	**132,924**	**193,491**	**302,697**	**629,112**

Table 4. The extent (hectares) and severity of aspen defoliation in 2012 by pest species in Alberta

Pest	Defoliation Extent by Severity Categories			TOTAL
	Light	Moderate	Severe	
Forest Tent Caterpillar	132,809	193,029	302,697	628,535
Large Aspen Tortrix	115	462	0	577
TOTAL	**132,924**	**193,491**	**302,697**	**629,112**

An aspen stand severely defoliated by the forest tent caterpillars (Mike Maximchuk)

Other Broadleaf Defoliators

The 2011 willow leafminer (*Micruapteryx salcifoliella*) outbreak that prevailed across the province collapsed in 2012. Aerial overview surveyors recorded a small patch of six hectares defoliated by this pest over the Upper Athabasca Corporate Region. Willow leafminer did not kill extensive stands of willow, as feared in 2011.

Diseases

Red Ring Blight of Pine, *Dothistroma septosporum*

The red ring blight is a major pest of pines in the southern hemisphere. This fungal disease caused extensive defoliation and tree mortality in lodgepole pine plantations of British Columbia in the recent past. Even mature pines could succumb to this disease. Increase in summer precipitation is believed to be responsible for recent escalation of red ring blight impact in British Columbia.

In 2012, the red ring blight was detected on a high value lodgepole pine gene bank at the Alberta Tree Improvement and Seed Centre (ATISC). This pathogen was detected during a routine annual survey of ATISC trees by a consultant, Dr. Herb Cerezke. The infected-trees were characterized by thin foliage, dead branches in the lower crown, and trees declining with reduced vigour. Two forest pathologists (Dr. Tod Ramsfield and Colin Myrholm) at the Northern Forestry Centre of Canadian Forest Service identified the causative organism of this disease as *Dothistroma septosporum*, the red ring blight of pines. This was the first detection of this disease on forest trees in Alberta. In view of the potential impact of this pest on high value gene banks, the Forest Health Section is planning to spray a fungicide in 2013 to control this disease.

Red ring blight-infected trees at the Alberta Tree Improvement and Seed Centre (Tom Hutchison)

Rhabdocline Needle Cast, *Rhabdocline pseudotsugae*

In 2012, a needle cast causing fungal pathogen, *Rhabdocline pseudotsugae*, infected Douglas fir resulting in premature dropping of needles in a progeny trial located near Rocky Mountain House. This is a common disease in many Rocky Mountain states in the United States. Wet weather is known to promote occurrence of this disease. Usually, the impact of this disease is minor and limited to loss of aesthetic value of the affected trees.

Abiotic Damaging Agents

Figure 13 shows spatial distribution of aerially visible damage caused by various disorders over the Green Area, as recorded during the overview aerial surveys in 2012.

Overall, the total area affected by various disorders in 2012 was less than that reported in 2011. The details of these damages are listed below, in alphabetical order:

Aspen die-back
(Mike Maximchuk)

Aspen Dieback

Light aspen dieback occurred over an estimated 999 hectares of the Upper Athabasca Corporate Region. The exact cause of aspen dieback has not been established. It is attributed to a combined effect between defoliator damage and drought stress. Aspen stands with similar damage that were observed in the other ESRD corporate regions of the province in 2011 have recovered.

Blow-down
(Anon., ESRD)

Blowdown

Blowdowns caused light damage in forest stands over the Upper Athabasca Corporate Region (184 hectares) and the North Saskatchewan Corporate Region (922 hectares).

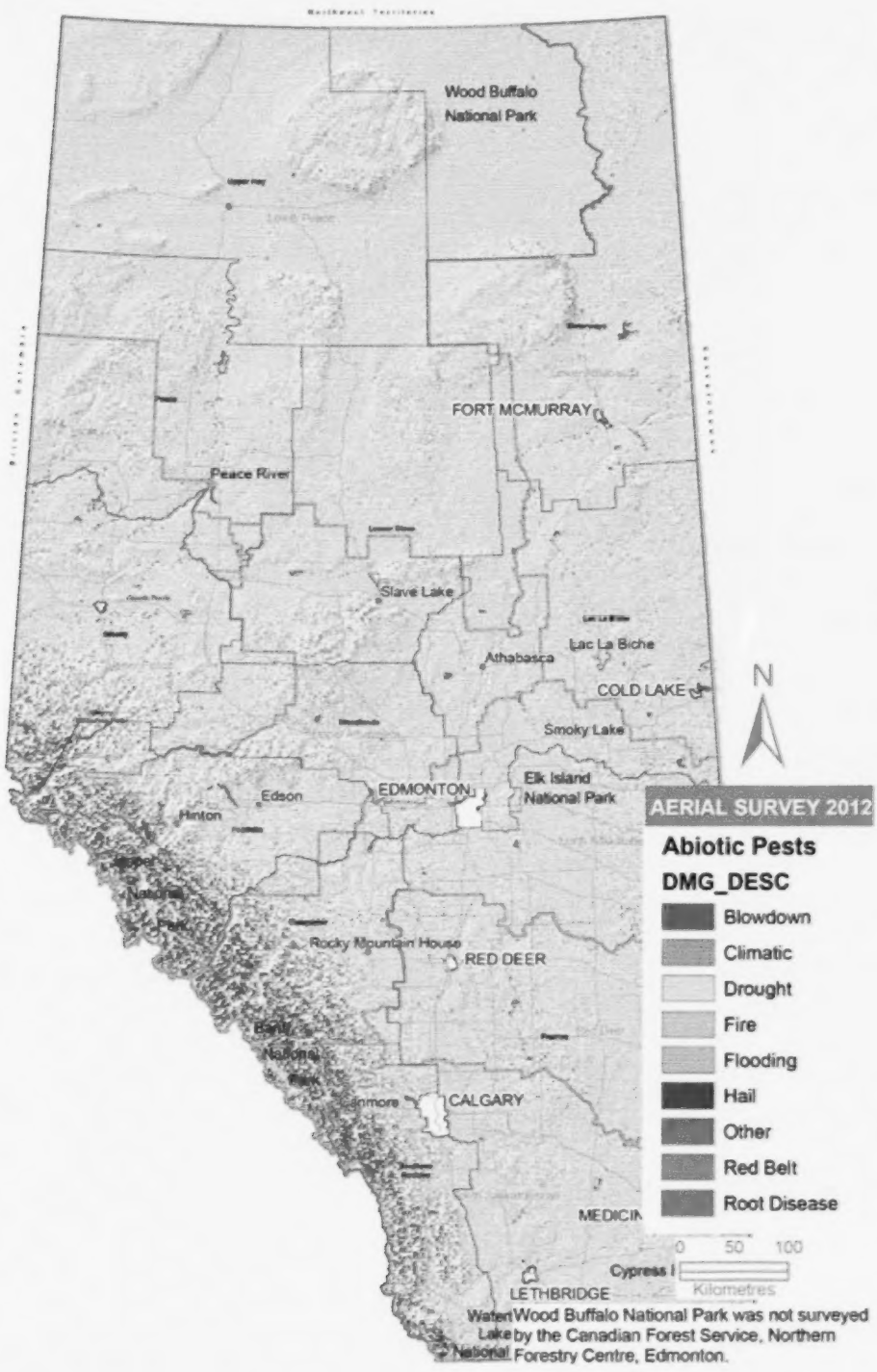
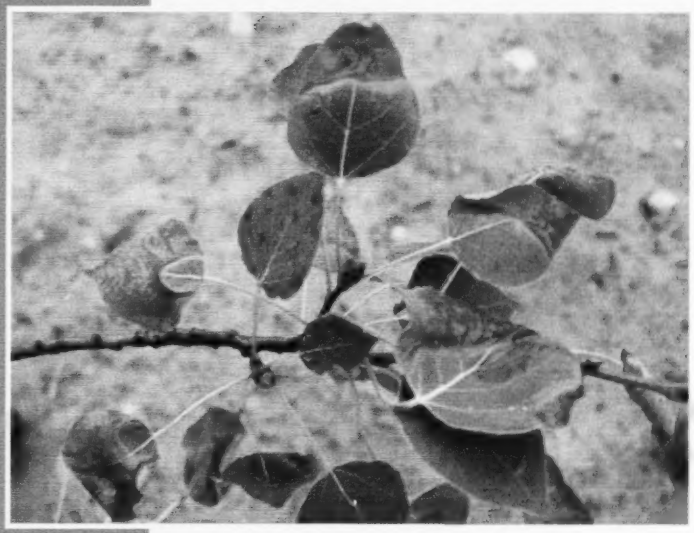


Figure 13. Spatial distribution of damage caused by abiotic disorders in the Green Area of Alberta in 2012.



Close-up of drought symptoms on poplar (Tom Hutchison)

Drought

Extensive areas of forest stands affected by drought reported in 2011 were no longer visible during overview aerial surveys carried out in 2012. In 2012, drought caused light damage on forest stands over the Lower Athabasca Corporate Region (14,832 hectares) and the North Saskatchewan Corporate Region (727 hectares). Drought damage was moderate over the Lower Peace Corporate Region (932 hectares) and the Lower Athabasca Corporate Region (12,213 hectares). Drought damage was severe over 1,089 hectares in the Lower Peace Corporate Region and 12,446 hectares in the Lower Athabasca Corporate Region.

Flooding

Water-logging caused light damage over small patches of forest stands in the Upper Athabasca Corporate Region (117 hectares) and in the Upper Peace Corporate Region (184 hectares).

Hail

Hail damaged a relatively small patch of 648 hectares over the Upper Athabasca Corporate Region in 2012.

Close-up of red belt at Cataract Creek (Brad Jones)

Red Belt

Red belt was less prominent in 2012 compared to its occurrence in 2011. Light red belt occurred over relatively small patches of forest stands over the Upper Peace (27 hectares) and Upper Athabasca corporate regions (792 hectares). In comparison, nearly 30,000 hectares of forested land were affected by moderate to severe red belt in 2011.

Invasive Plant Species Program in 2012

Introduction

This program covers invasive plant species detection, surveys and management in the Green Area of the province. Relatively large areas with either noxious or prohibited noxious invasive plants growing on Crown land are the main focus of this program. However, early detection and rapid response are taken to manage either new or low-level invasive plant infestations found either on high value sites or on vacant land.

The objectives of this program are to:

- carry out surveys to detect, and to estimate the extent of either noxious or prohibited noxious invasive plant species at selected sites in the Green Area of the province;
- manage invasive plants on ESRD occupied sites and on vacant Crown land, as required by the *Weed Control Act*;
- initialize and/or continue localized weed cooperative projects with high probability of success over designated high value areas;
- detect early and take rapid response to manage invasive plants that occur at relatively low levels, new infestations occurring either on vacant land or on high value sites; and,
- continue ongoing education and increased awareness initiatives.

Invasive Plant Detection and Distribution Surveys

Table 5 contains a list of invasive plant species that were observed during ground surveys carried out at selected sites in the Green Area in 2012. The survey sites in 2012 included ESRD facilities such as cabins, campgrounds, wildfire bases, staging areas, wildfire lookout tower sites and vacant Crown land, such as random camp sites, abandoned forestry roads and quad trails.

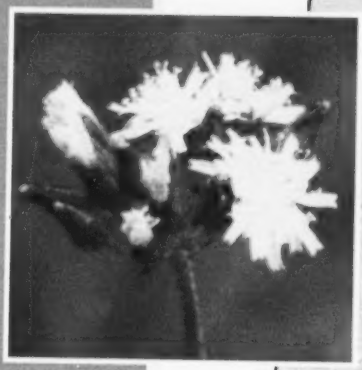
Figures 14-19 show occurrences of six invasive plant species at selected sites monitored in 2012 in the Green Area, in relation to their historical occurrences. However, these surveys did not systematically cover the entire Green Area of Alberta. Within the surveyed areas, tall buttercup, scentless chamomile and ox-eye daisy were the predominant invasive plant species found in 2012. Infestations of hawkweed - some species are prohibited noxious - in the Upper Athabasca (Foothills Area) and South Saskatchewan (Southern Rockies Area) corporate regions continue to be problematic. Yellow-devil hawkweed, an un-regulated non-native hawkweed, has been found in the area of the 2003 Lost Creek fire. This 2000-hectare patch exceeds all practical control methods.

Table 5. Invasive plant species observed during ground surveys carried out over selected sites in the Green Area of Alberta in 2012

Common Name	Scientific Name	Occurrence
Black henbane	*Hyoscyamus niger* L.	3
Blueweed	*Echium vulgare* L.	3
Canada thistle	*Cirsium arvense* (L.) Scop.	1, 2, 3, 6
Common mullein	*Verbascum thapsus* L.	3
Common tansy	*Tanacetum vulgare* L.	1, 2, 3
Common toadflax	*Linaria vulgaris* Hill.	3
Creeping bellpower	*Campanula rapanculoides* L.	2
Dalmatian toadflax	*L. dalmatica* L.	3
Diffuse knapweed[2]	*Centaurea diffusa* Lam.	3
Field scabious	*Knautia arvensis* (L.) Duby	3
Hound's tongue	*Cynogllossum officinale* L.	3
Leafy surge	*Euphorbia esula* L.	3
Meadow hawkweed[2]	*Hierarcium caespitoum* Dumort.	2, 3, 4
Orange hawkweed[2]	*Hieracium aurantiacum* (L.)	1, 2, 3, 6
Ox-eye daisy	*Chrysanthemum leucanthemum* L.	1, 3
Perennial sow-thistle	*Sonchus arvensis* L.	2
Scentless chamomile	*Matricaria perforata* Merat.	1, 2, 3, 5
Spotted knapweed[2]	*Centaurea maculosa* Lam.	3
Tall buttercup	*Rananculus acris* L.	1, 2
Tall hawkweed	*Hieracium piloselloides* Vill	3, 4
White cockle	*Lychnis alba* Mill	1, 4, 7
Wild caraway	*Carum carvi* (L.)	1, 3
Yellow clematis	*Clematis tangutica*	3
Yellow devil hawkweed	*Hieracium glomeratum* L.	2, 3

[1] ESRD corporate areas: 1. Clearwater 2. Smoky 3. Southern Rockies 4. Foothills 5. Waterways/Lac La Biche 6. Woodlands, 7. Lesser Slave.

[2] Prohibited noxious weeds



Yellowdevil hawkweek (Anon., Agriculture and Rural Development)

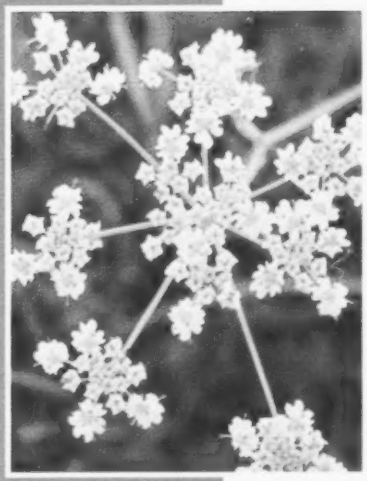
Figure 14. Distribution of hawkweed at selected survey sites in the Green Area of Alberta in 2012.

Scentless chamomile
(Tom Hutchison)

Figure 15. Distribution of scentless chamomile at selected survey sites in the Green Area of Alberta in 2012.

Tall buttercup
(Brad Jones)

Figure 16. Distribution of tall buttercup at selected survey sites in the Green Area of Alberta in 2012.



Wild caraway flower
(Brad Jones)

Figure 17. Distribution of wild caraway at selected survey sites in the Green Area of Alberta in 2012.

Ox-eye daisy plant (Anon., Alberta Agriculture, Food and Rural Development).

Figure 18. Distribution of ox-eye daisy at selected survey sites in the Green Area of Alberta in 2012.

Perennial sow-thistle plants (Danny Brown)

Figure 19. Distribution of perennial sow-thistle at selected survey sites in the Green Area of Alberta in 2012.

Invasive Plant Management

In 2012, ESRD in conjunction with municipalities and industry partners carried out several projects to manage invasive plant species in the Green Area. Ecological, mechanical and herbicidal methods were used in these management programs. Weed management co-ops formed by ESRD, forest Industry and municipality partnerships led to successful weed management programs in 2012.

The successional project, i.e., planting willow stakes and plugs to combat scentless chamomile in the Amadou Lake area in the Lower Athabasca Corporate Region, was evaluated. The willow plugs showed the best establishment and monitoring in subsequent years will bear out whether this is a long-term technique to manage invasive plants in forested areas.

As a mechanical control, crews and/or volunteers hand-pulled invasive plants on vacant Crown lands and on ESRD sites such as wildfire lookouts, wildfire bases, warehouse compounds, and a fuel-cache site. In 2012, noteworthy mechanical control sites were Amadou Weed Co-op site where about 180 m^3 of scentless chamomile were pulled and subsequently burned in co-operation with the Athabasca Waste Commission, the Castle Crown Wilderness Coalition (CCWC) handpicking weeds in the south Castle, and "Pull a Weed Day" at the Brule Sand Dunes.

ESRD sprayed herbicides over numerous patches of invasive plants detected (Table 5) across the Green Area in 2012. The sprayed areas included ESRD facilities and vacant Crown lands.

Invasive Plant Co-operatives

In the North Saskatchewan Corporate Region (Clearwater Corporate Area), a weed co-op involving Clearwater County, one forest company, one private landowner and three oil and gas companies completed spray projects; these cooperative projects achieved effective weed control in the Clearwater Corporate Area. In the Lower Athabasca Corporate Region, staff concentrated primarily on finishing up the commitments associated with the Amadou Weed Cooperative. In the Foothills Corporate Area of the Upper Athabasca Corporate Region, Yellowhead County and ESRD collaborated under the Yellowhead Invasive Plants Initiative by hosting two open houses to discuss issues and control plans, with an emphasis on the new hawkweed infestation. In the Southern Saskatchewan Corporate Region (Southern Rockies Corporate Area), ESRD maintains Memorandums of Understanding with the Municipal District of Crowsnest Pass and the Municipal District of Ranchlands to facilitate efficient and effective invasive plant control.

Education and Increased Awareness

The Annual Northeast Weed Co-op Workshop was the highlight of numerous programs carried out in 2012 to educate the general public and stakeholders to increase their weed awareness. This workshop was conducted for the seventh consecutive year in Athabasca. Among the other educational activities that increased weed awareness were: a) public open house held at Cadomin under the patronage of Yellowhead Invasive Plants Initiative; b) "Pull a Weed Day" in Brule Sand Dunes; c) hawkweed open house in Hinton attended by 14 industry representatives, a Commercial Trail Ride licensee, and 10 ESRD/ Tourism, Parks and Recreation (TPR) staff; and, d) an invasive plants presentation to 60 oil and gas operators organized and presented by the Foothills Corporate Area of the Upper Athabasca Corporate Region.

ESRD staff made several presentations to increase weed awareness of wildfire crews, mountain pine beetle crews, forest officers, and junior forest ranger crews. Invasive plant extension materials (pamphlets, posters, identification guides) were made available to the general public at various locations in the Foothills and Clearwater corporate areas.

Collaborative Programs

Martin Robillard, Forest Health Technician, hanging a Delta trap used in annual gypsy moth survey in Alberta (Tom Hutchison)

Annual Gypsy Moth Detection Surveys

In 2012, the Forest Health Section of ESRD deployed 55 pheromone-baited Delta traps to detect presence of gypsy moths over the Green Area of Alberta. This was a part of a province-wide annual survey coordinated by the Canadian Food Inspection Agency (CFIA). Figure 20 shows the locations of these gypsy moth traps. No gypsy moths were caught in the traps deployed by the ESRD in 2012.

Monitoring of Climate Impacts on the Productivity and Health of Aspen (CIPHA)

The Forest Health Section monitors CIPHA nodes, under a Letter of Agreement signed in 2010 between the ESRD and Natural Resource Canada (NRCan). The CIPHA nodes are located in the provinces from British Columbia to Ontario and in the Northwest Territories. Each node covers three aspen fields; each field has two monitoring plots.

The intent of this collaboration is to monitor the nodes located in Alberta, as part of a research project on interactions among climate, forest Insects and diseases, and trembling aspen.

In 2012, the Forest Health Team monitored plots in eight out of the nine nodes; the ninth node was monitored by a team from the Northern Forestry Centre of the Canadian Forest Service. The Forest Health Team annually records defoliation, dieback, foliage compliment, and signs and symptoms of pests. In 2012, in addition to the above records, this team also took increment core samples of selected trees for dendrochronological studies and recorded tree heights, diameters at breast height (dbh) and tree crown heights of selected trees, as they do every five years.

The Forest Health Team submitted the collected data to the researchers at the Northern Forestry Centre for analysis.

Figure 20. The locations of gypsy moth traps deployed by ESRD in 2012 in Alberta.

A node for monitoring Climate Impact on Productivity and Health of Aspen in Alberta Tom Hutchison)

Whitebark and Limber Pine Recovery Plan

In 2012, the Forest Health Section of the Forestry and Emergency Response Division and the Fish and Wildlife Branch of the Policy Division of ESRD continued co-leading a project to develop a recovery plan to protect whitebark pine and limber pine in Alberta. These two species have been designated as endangered species under the Alberta Wildlife Act in 2009. These five-needle pines are keystone species that play key roles as important nutritive food sources for birds and mammals.

In 2012, a contractor completed operating guidelines pertaining to whitebark and limber pines for the Enhanced Approval Process and a survey protocol for detection to accompany the guidelines.

MPB Spread Management Action Collaborative (SMAC) with Saskatchewan Ministry of Environment

In 2012, ESRD and Saskatchewan Ministry of Environment (SME) continued cooperating under a three-year Memorandum of Agreement (MOA) regarding control and management of MPB infestations of mutual interest. The mission of this MOA is to form a Spread Management Action Collaborative (SMAC) which would support and develop work plans as required by the MOA. Work plans were developed after MPB dispersal monitoring by using baits, aerial surveys, and ground surveys to determine green: red ratios, followed by the running of the Decision Support System. Funding for aerial surveys and photography, ground surveys including use of baits to monitor MPB dispersal, single tree control, and quality inspection carried out under this project were provided jointly by ESRD and SME. This project is led by Dan Lux (Senior Manager, Forest Health) on behalf of ESRD and by Dr. Rory McIntosh (Provincial Forest Entomologist and Forest Pathologist) on behalf of SME.

Cooperative Action with the Terrestrial Environmental Effects Monitoring (TEEM) Program of Wood Buffalo Environmental Association

The Wood Buffalo Environmental Association (WBEA) is a multi-stakeholder, not-for-profit organization that conducts air quality and terrestrial monitoring in the Regional Municipality of Wood Buffalo. Environment and Sustainable Resource Development (ESRD) is a member of this organization along with 22 other (industry, federal, NGOs, and First Nations) partners. WBEA operations are funded by oil sands operators.

WBEA invested considerable time and resources with a science team of some 30 contracted/staff scientists to put in place a forest health approach to forest monitoring, moving towards cause-effect linkage. This is because a likely impact of pollutant emissions to air will be predisposition of forest stands to adverse effects from various forest health damaging agents (such as insects, disease, and drought). The methodology chosen for assessing tree condition and data collection was a modified system developed by WBEA, based on the Acid Rain National Early Warning System (ARNEWS).

In 2011, (with the help of ESRD Forest Health Officer Tom Hutchison) annual forest condition surveys were initiated on 15 plots to track condition and pest incidence/severity. During these surveys, tree condition criteria such as: cone production, needle retention, crown condition, and woody tissue damage were assessed on in- plot and off-plot jack pines at each site. In 2012, these assessments were again conducted by staff of ESRD Forest Health and WBEA. More sites were included in 2012, bringing the total sites monitored to well over 20.

Increased Awareness and Training

Forest Health Newsletter

In 2012, the Forest Health Section published three issues of the "*Bugs and Diseases*" newsletter, which is now in its 23rd year. Among the topics covered in the 2012 edition were: MPB workshop held in Whitehorse, field trial on browsing, root damaging agents, training programs, whitebark and limber pine recovery plan, and spruce budworm.

Annual Report – Forest Health in Alberta

The 2011 annual report was published in June 2012. This was the 15th volume of this report. It covered details of incidence, extent, severity and management of forest health damaging agents in Alberta. In addition, details of forest health programs conducted to increase awareness, training of forest health personnel, and collaborative programs were reported.

Provincial Integrated Forest Pest Management Forum

During the past fifteen years, this forum has been held at the end of the field season in November to present the progress made on various operational and research projects to the stakeholders. In 2012, the Forest Health Section decided to change timing of this event in an effort to draw more forest industry participation, which in the past few years had been poor. The change in timing of this event was done in response to comments received from forest industry. These comments indicated preference to have this forum held in conjunction with another forest health-related event so that industry participants could justify attendance. Consequently, this forum was moved to spring 2013 and scheduled to be held back to back with the annual mountain pine beetle "Researcher – Practitioner Information Exchange Forum."

Attendees of the 2012 overview aerial survey workshop with Bill Ciesla (instructor)
(Anon., ESRD)

Workshop on Overview Aerial Surveys of Other Damaging Agents

In June 2012, the Forest Health Section organized a workshop aimed at expanding traditional forest health surveys to cover other forest health damaging agents. This was conducted in view of anticipated changes in forests and forest pests due to impending climate change. Such other damaging agents include bark beetles (Douglas fir beetle and balsam bark beetle), major forest diseases (foliar diseases and root diseases), and abiotic damaging agents (drought, hail, and windstorms). The objectives of this workshop were to: a) standardize aerial overview surveys in Alberta, and b) maintain a long-term record of these damaging agents to relate those records to changes associated with climate change that may occur in forests and in forest health damaging agents in Alberta.

A highly experienced consultant, Bill Ciesla, conducted this 3-day workshop held at Grande Prairie in June 2012. This workshop was composed of a classroom session and an aerial survey session. The classroom session covered details on how to recognize, monitor and assess damage caused by forest health damaging agents, from the air. The aerial survey session provided an opportunity to learn how to put knowledge gained in the classroom lessons into practice.

This training program was attended by 18 ESRD staff with varying levels of experience ranging from veteran surveyors to rookies who have never carried out aerial surveys. This workshop was well received by the trainees who raised many questions that generated fruitful discussions. The rookie trainees benefitted most by the limited overview aerial survey practice session.

Training Young Stand Survey Contractors of Foothills Growth and Yield Association

Two experienced Forest Health Officers, Brooks Horne and Tom Hutchison, conducted a training session on June 21 to train 15 contractor staff of the Foothills Growth and Yield Association (FGYA). This is the third training session conducted by them in the past five years to train FGYA contractor staff. The trainees were exposed to common forest health damaging agents of young stands found at three different lodgepole pine regeneration plots. Among the common young stand pests encountered were the root collar weevil, Armillaria root disease, pitch blister moth, various rusts, needle cast and abiotic agents such as hail. Since these training sessions began, the diagnostic skills of these crews have improved resulting in better quality data being reported by them. Brooks and Tom are planning to conduct more refresher courses in the future for these crews.

MPB Workshop in Whitehorse, Yukon

Erica Samis, Senior Forest Health Officer, was a key speaker at the MPB workshop held in Whitehorse in June 19-20, 2012. MPB infestations have been reported within 80 kilometres of the BC-Yukon Territory border. This prompted the Yukon Territory authorities to hold this workshop to determine how to carry out MPB risk analysis, evaluate values at risk and to plan potential responses to MPB. They also wanted to educate their stakeholders on MPB, and identify stakeholder views on this problem and values at risk.

Erica's presentation showcased Alberta's integrated and comprehensive MPB management program. It covered the history, current status, objectives, risk analysis, management strategies and partnerships involved. Her presentation was well received leading to questions and further discussions with the audience. ESRD is planning to extend assistance if the Yukon Territory carries out MPB programs in the future.

Appendix 1

ESRD corporate regions and corporate areas of Alberta, 2012.